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REPORT ON POLLUTION OF INTERSTATE WATERS OF THE NORTH PLATTE RIVER, WYOMING-NEBRASKA

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September 1961

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WYOMING-NEBRASKA

U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
ROBERT A. TAFT SANITARY ENGINEERING CENTER

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Pollution of the 67-mile reach of the North Platte River from Torrington, Wyoming, to Bridgeport, Nebraska, was investigated during December 1960. Sources were determined to be partially treated sewage from a sugar and an oil processing plant, municipal wastes, and agricultural wastes. The combined pollution from all sources severely damages the potential fishery of this water, destroys the aesthetic appeal of the stream, renders recreational use of the water hazardous to health, and renders the water unsuitable as a source of supply for domestic and many industrial uses.

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REPORT ON
POLLUTION OF INTERSTATE WATERS OF THE
NORTH PLATTE RIVER
WYOMING-NEBRASKA

BACKGROUND

Pollution of the North Platte River in the reach from Torrington, Wyoming, to Bridgeport, Nebraska, was investigated during 1949 and 1950. This was a cooperative undertaking of the water pollution control agencies of the states of Nebraska and Wyoming, and of the U. S. Public Health Service Missouri Drainage Basin Office.

The June, 1949, study revealed excessive bacterial contamination by sewage, with the highest densities below Scottsbluff and downstream to Bridgeport. No serious effects of organic wastes were indicated by the biochemical oxygen demand (B.O.D.) and dissolved oxygen (D.O.) data. During June, however, stream flows were relatively high, and no final conclusion could be drawn from the 1949 data regarding probable

effects of organic pollution when stream flows dropped to a minimum in summer months.

The data for November, 1950, when the 5 beet sugar plants in the area were in operation, indicated gross pollution throughout much of the Torrington-Bridgeport reach of the North Platte. Bacterial contamination was much higher than in June, and high B.O.D. levels and significant oxygen depletion occurred below both Torrington, Wyoming, and the Scottsbluff-Gering, Nebraska, area.

The report containing the results of those studies recommended that sewage and industrial waste treatment plants be provided by essentially all of the towns and major industries involved.

Subsequently Torrington has provided stabilization ponds for its sewage, and the Great Western Sugar Company plant at Bayard, Nebraska, has provided facilities for broad field disposal of its wastes. The other 4 beet sugar plants have undertaken various measures, many of them within their processes, designed to reduce their wastes.

In November and December, 1960, the Public Health Service conducted stream studies to determine present

stream quality during the beet sugar campaign. This report deals with the bacteriological, chemical, and physical data obtained during the December study. The biological results of the November study will be presented separately.

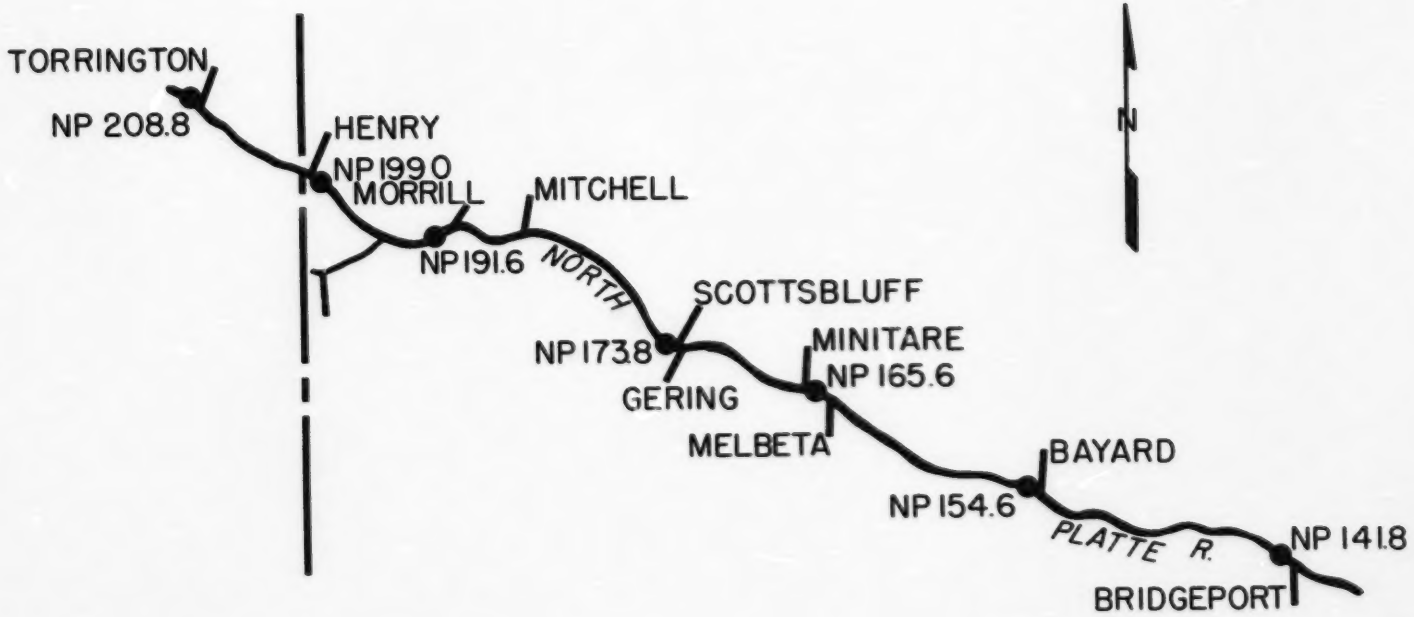
THE AREA

The reach of the North Platte River, covered by the December study extended from Torrington, Wyoming to Bridgeport, Nebraska, a distance of 67 miles by river. This reach is shown on Chart 1.

The concentrations of sewered communities and waste-producing industries in this area are greater than those along any other comparable reach of the North Platte.

One town in Wyoming and 15 in Nebraska are situated on or near this reach of the river. Of these 12 are sewered.

There also are 15 industrial plants discharging wastes directly to this reach of the river, with the greatest concentration in the Scottsbluff-Gering, Nebraska, area. The industries reflect the agricultural economy of the surrounding area, with all but one processing agricultural products such as sugar beets, vegetables, livestock and poultry, or milk. The agriculture is largely dependent on use of the North Platte River water for irrigation.



WASTES

SAMPLING STATIONS

NORTH PLATTE RIVER
TORRINGTON, WYOMING, TO BRIDGEPORT, NEBRASKA

CHART I

WATER USES

The area adjacent to this reach of the North Platte is a gridwork of canals drawing water from the river for irrigation, and drains for returning flow from the irrigated fields to the river. There are 4 diversion dams, and at least 16 canals and 28 drains are directly connected to the 67 miles of river. In 1950 there were about 376,000 acres of irrigated area in more than 3,000 farms in the 3 counties through which this reach of the river flows. The counties are Goshen in Wyoming, and Scotts Bluff and Morrill in Nebraska.

The Holly Sugar Company plant at Torrington takes a portion of its water supply from the North Platte, and the remainder from wells. Other industrial plants downstream, in Nebraska, depend principally on wells and surface drains for their water supplies. The river water generally is preferable to underground water in this area because of high hardness content of the ground waters.

There is no known use of the river for domestic purposes, but in many areas of the country it is common practice to draw water from irrigation canals for farm water supplies. It is probable that such use is made of the numerous canals and drains of the North Platte irrigation system. It also is quite probable that the system is used for livestock watering. Information is needed on these two potential uses.

Fish are taken from the irrigation ditches, and the river itself has potential as a fishery. This potential resource of the river and the impact of pollution on it will be covered in a separate presentation.

The swift, shallow river has only limited potential for boating and swimming, but wherever people have access to water there almost inevitably is some boating and swimming, and this reach of the North Platte probably is no exception. Information on this potential also is needed.

The river is heavily used for waste disposal by both municipalities and industries, many of which have

either inadequate or no facilities for reduction in sewage and industrial wastes before discharge to the stream.

SOURCES OF WASTES

Table 1 lists sewered communities from Torrington, Wyoming, to Bridgeport, Nebraska, which are sources of contamination of river water by sewage bacteria.

Table 2 lists sources of organic wastes discharged to this reach of the North Platte. This list includes both municipal sewerage systems and industrial plants.

The basic information for these tables was taken from the U. S. Public Health Service 1957 Inventory of Municipal and Industrial Waste Facilities.

SEWAGE

Table 1 includes data on both the sewered populations of the municipalities involved, and estimated bacterial population equivalents (BPE) of the sewage as discharged to the river. Where the BPE value is less than the corresponding sewered population, the difference represents the reduction in potential bacterial contamination resulting from treatment. For example,

TABLE 1

SOURCES OF SEWAGE DISCHARGE TO STREAM

SOURCE	SEWERED POPULATION	BACTERIAL POPULATION EQUIVALENT TO STREAM	PER CENT OF TOTAL DISCHARGE TO STREAM
Wyoming			
Torrington	3,500	0*	0.0
Holly Sugar Co.	270	135	0.7
Nebraska			
Henry	80	80	0.4
Lyman	350	350	1.9
Morrill	600	600	3.3
Mitchell	1,800	1,800	10.0
Scottsbluff	9,000	9,000	50.0
Terrytown	1,500**	1,500	8.3
Gering	2,000	1,000	5.6
Minatare	800	800	4.4
Melbeta	80	80	0.4
Bayard	1,700	1,700	9.4
Bridgeport	1,000	1,000	5.6
TOTALS	22,680	18,045	100.0

* No overflow from Torrington sewage stabilization ponds during December, 1960, study.

** Estimated sewered population.

TABLE 2

SOURCES OF ORGANIC WASTE DISCHARGE TO STREAMS

SOURCE	B.O.D. POPULATION EQUIVALENT * INDIVIDUAL SOURCE	TOTAL FOR AREA	PER CENT OF TOTAL
Wyoming			
Torrington	0	370,000	27.17
Holly Sugar Co.	370,000		
Nebraska			
Henry	800	1,300	0.10
Platte Valley Poultry	500		
Lyman	350	350	0.03
Morrill	840	840	0.06
Mitchell	2,600	158,600	11.65
Great Western Sugar Co.	156,000		
Scottsbluff	12,520	646,950	47.51
Co-op Cannery	4,000		
Co-op Oil Refinery	1,200		
Flicker Packing Co.	550		
Great Western Sugar Co.	623,000		
H. & B. Packing Co.	720		
Hersch Packing Co.	1,160		
Idlewild Dairy	1,600		
Scottsbluff Rendering	2,200		
Terrytown	1,500	1,500	0.11
Gering	1,400	130,500	9.58
Great Western Sugar Co.	96,000		
Miller Packing Co.	100		
Swift & Co.	33,000		
Melbeta	80	80	0.01
Minatare	800	800	0.06
Bayard	1,700	49,700	3.65
Great Western Sugar Co.	48,000		
Bridgeport	1,000	1,000	0.07
TOTALS	1,361,620	1,361,620	100.00

* Data from U. S. Public Health Service 1957 Inventory of Municipal and Industrial Waste Facilities, with exception of PE for Torrington municipal discharge, from which there was no discharge during December, 1960, study.

Torrington, Wyoming, with a sewered population of 3,500, discharged an estimated BPE of zero to the stream. Torrington had installed stabilization ponds for treatment of the sewage previous to the 1960 river study. As the ponds had not filled sufficiently to overflow to the river during the 1960 study there was no discharge of sewage during that period.

The sewage from the 270 employees of the Holly Sugar Company at Torrington passed through a septic tank before discharging to the river. It is estimated that this treatment reduced the bacterial content of the sewage by 50 per cent, to a BPE of 135.

Similarly, the Gering, Nebraska, sewage was passed through a septic tank before discharged to the stream, and the bacterial contamination from the 2,000 sewered population was reduced to an estimated BPE of 1,000.

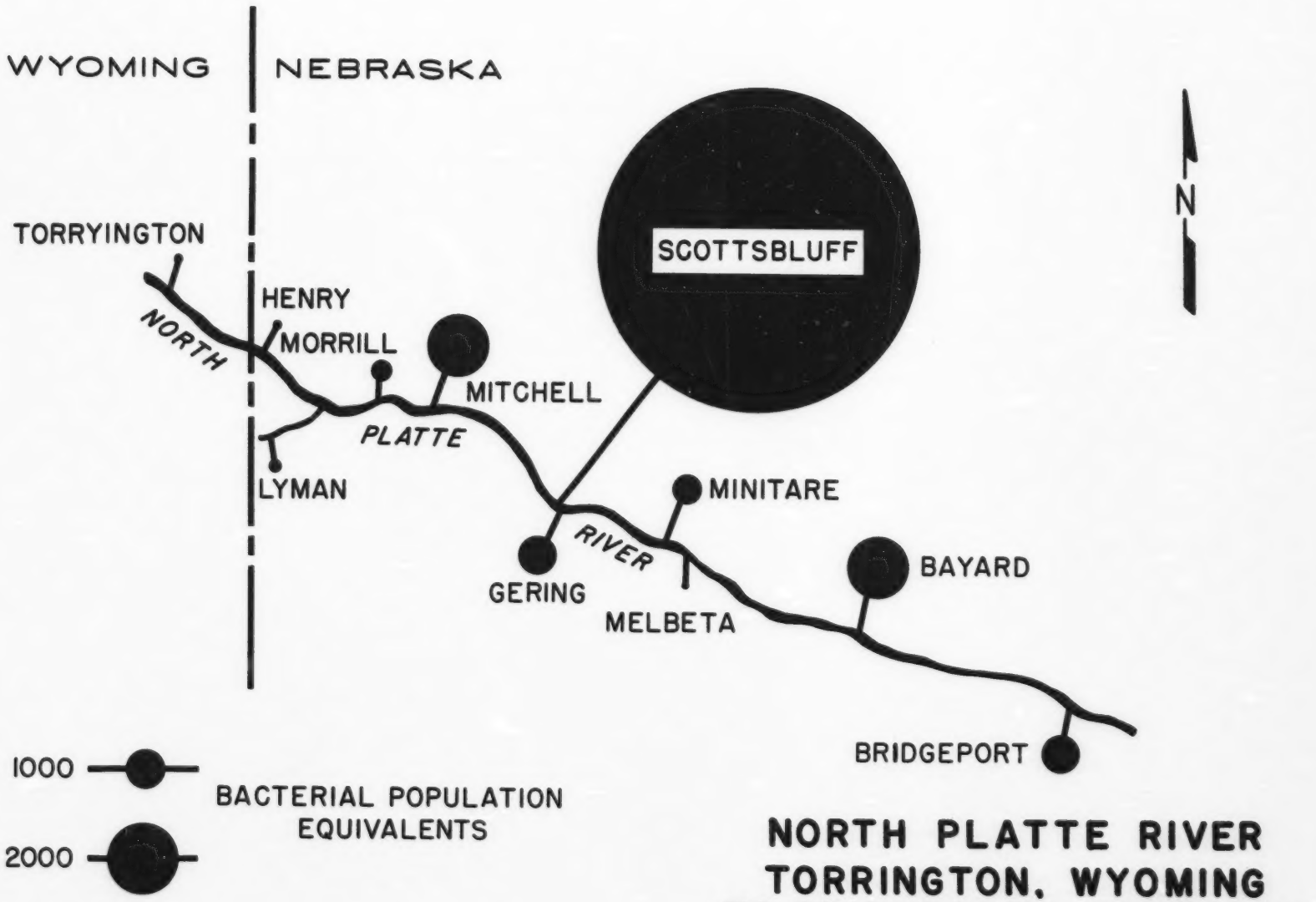
All other communities discharged sewage without treatment, and the sewered population and the BPE of each were the same. Melbeta, Nebraska had a septic tank, but it was reported not in use.

The potential bacterial contamination from the total 22,700 sewered population in the entire area was reduced nearly 21 per cent by treatment, to a BPE of 18,000. More than 15 per cent of the total reduction was at Torrington.

Scottsbluff has received approval for a grant for construction of a sewage treatment plant.

Chart 2 represents the sources of sewage discharged to this reach of the North Platte River. The circles indicate the relative contributions of sewage bacteria from the various sources, with the diameter of the circle at each source in proportion to contributions from all other sources.

Of the 18,000 total BPE, less than 1 per cent was discharged from the Holly Sugar Company plant at Torrington in Wyoming. All other sewage was discharged from communities in Nebraska. Scottsbluff sewage discharge accounted for one half of the total BPE. Bayard, Mitchell, and Terrytown accounted for between 8 and 10 per cent each, Gering and Bridgeport for 5.6 per cent each, and the other 5 communities between 0.4 and 4.4 per cent.



NORTH PLATTE RIVER
TORRINGTON, WYOMING
TO BRIDGEPORT, NEBRASKA
SOURCES OF SEWAGE

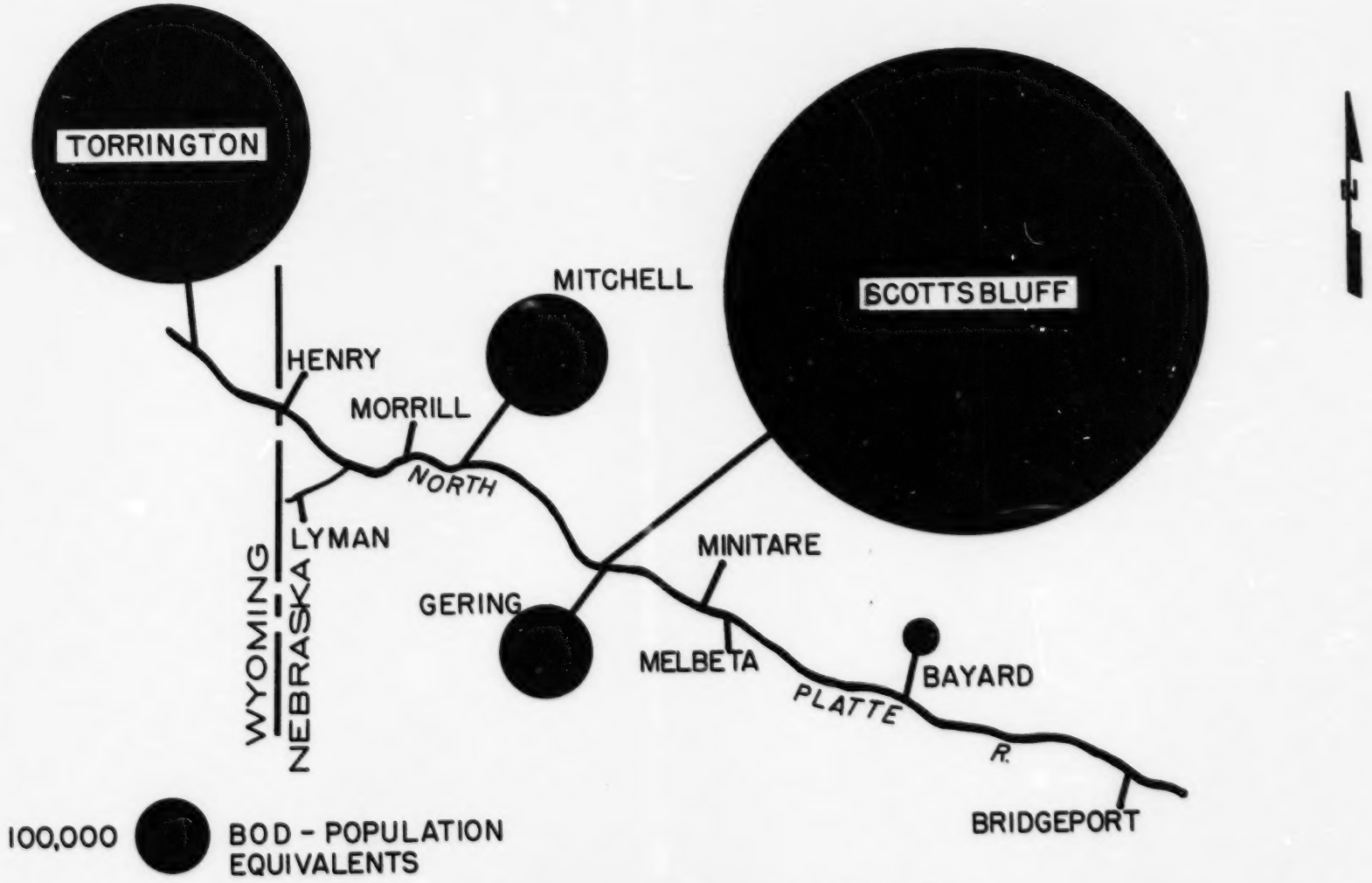
CHART 2

ORGANIC WASTES

Table 2 gives estimates of the oxygen demanding strength of both sewage and industrial wastes discharged to the North Platte River from Torrington to Bridgeport. The oxygen demanding strength is expressed in population equivalents (PE), with one PE equal to the oxygen demand exerted by the sewage from one person. The table includes the PE from each source, and also a total for all wastes, both sewage and industrial, from each community.

Chart 3 presents the relative PE from each community. Here again the diameter of each circle is in proportion to the PE for all other sources in the area.

The total PE for the entire area was 1,362,000. Of this total, a little more than one quarter was from the Holly Sugar Company at Torrington. Nearly one half was from Scottsbluff and its associated industries. Mitchell and its industry accounted for nearly 12 per cent, Gering and its industries for nearly 10 per cent, and Bayard and its industry for less than 4 per cent. Contributions from the other 7 communities and their industries ranged between 0.01 and 0.11 per cent.



NORTH PLATTE RIVER
TORRINGTON, WYOMING TO BRIDGEPORT, NEBRASKA
SOURCES OF ORGANIC WASTES
CHART 3

The 5 beet sugar plant wastes accounted for 1,293,000 of the 1,362,000 total PE. Thus the beet sugar plants, when in operation, accounted for 95 per cent of the total organic wastes discharged to this reach of the river. One plant alone, the Great Western Sugar Company plant at Scottsbluff, accounted for nearly 46 per cent of the total. The Holly Sugar Company plant, with a little more than 27 per cent, was the second largest contributor of organic wastes. The Great Western Sugar Company plants at Mitchell contributed 11.5 per cent, at Gering 7.1 per cent and at Bayard 3.5 per cent.

IRRIGATION RETURN WATER

Use of water for irrigation generally results in considerable increase in mineral content of the water. Although data are not available to permit adequate evaluation of this factor in the reach of the North Platte under consideration, it is almost inevitable that there is a marked increase in mineralization of the river during the irrigation season.

During a biological survey in August, 1950, alkalinity was determined at points along most of the length of the North Platte. The results showed an increase in alkalinity from about 120 mg/l above the Torrington to Bridgeport reach to a maximum of 290 mg/l below the reach. This is an indication of one of the effects of irrigation return water, but information would be needed on hardness, sodium, calcium, magnesium, sulfates, and chlorides for full evaluation of this effect.

EFFECTS ON WATER QUALITY AND USES

A study of the effects of pollution on chemical, bacterial, and physical quality of water was conducted during the period December 7 through 13, 1960.

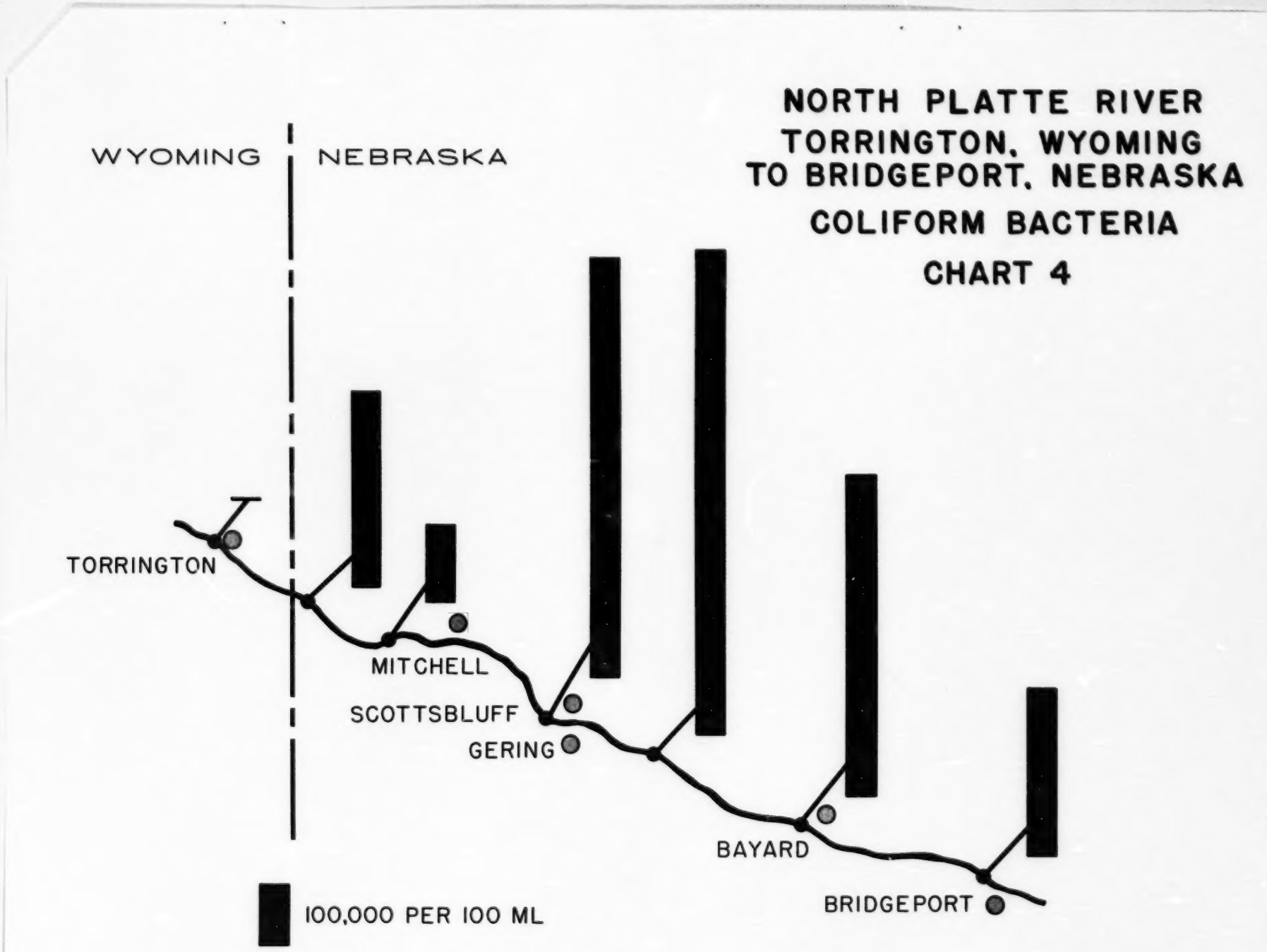
Samples were collected once daily at each of the 7 stations shown on Chart 1. Determinations on the samples included temperature, pH, alkalinity, D.O., B.O.D., total suspended solids, and coliform bacteria. In addition daily samples were collected from the Holly Sugar Company waste discharge for determination of temperature, and total and fixed suspended solids.

Provisional data on stream flow at the sampling stations were obtained from the U. S. Geological Survey.

The results of this study are presented in the Appendix.

COLIFORM BACTERIA

Chart 4 presents information on the average most probable numbers (MPN) of coliform bacteria found at the


NORTH PLATTE RIVER
TORRINGTON, WYOMING
TO BRIDGEPORT, NEBRASKA
COLIFORM BACTERIA
CHART 4
WYOMING
NEBRASKA
TORRINGTON
MITCHELL
SCOTTSBLUFF
GERING
BAYARD
BRIDGEPORT
100,000 PER 100 ML

sampling stations. The heights of the bars indicate the densities of coliforms at the stations.

Bacterial contamination of the North Platte above Torrington (NP-208.8) was quite low, with a MPN of only 214 per 100 ml. Below the Holly Sugar Company plant sewage and industrial waste discharge the coliform MPN rose to 329,000 per 100 ml near the state line (NP-199.0). This represented a 1500-fold increase in bacterial contamination.

At the next station downstream (NP-191.6) above Mitchell, Nebraska, the coliform MPN dropped to 132,000 per 100 ml. Below the Mitchell sewage discharge and the Great Western Sugar Company industrial waste discharge (NP-173.8) the MPN increased to 704,000 per 100 ml. This density and all others downstream below this station, included some residual of the coliform bacteria from the Holly Sugar Company waste discharge.

The Scottsbluff-Terrytown-Gering area, with raw and partially treated sewage discharges, and wastes from the numerous industries, including 2 Great Western Sugar Company plants, the Swift and Company plant, and several smaller meat processing plants, is the largest source of

coliform bacteria along this reach of the North Platte. Below the area (NP-165.6) the MPN increased to 815,000 per 100 ml, the highest value found during the study. This value was 3,800 times the MPN of the relatively uncontaminated stream above Torrington.

Downstream from this point the coliform densities dropped to 537,000 per 100 ml just above Bayard (NP-154.6), and to 279,000 at Bridgeport, despite the discharge of sewage from Minatare, Melbeta and Bayard, and the treated wastes from the Great Western Sugar Company plant at Bayard.

The principal contributors to the extremely high densities of coliform bacteria throughout the river reach from below Torrington to Bridgeport are the raw and partially treated sewage, the beet sugar wastes, and the livestock and poultry packing wastes.

The coliform bacteria density commonly accepted as satisfactory for sources of domestic water supply for which adequate treatment is provided, and for general recreation, exclusive of bathing, is an average of 5,000 per 100 ml. For bathing, a commonly accepted limit is 1,000 per 100 ml. Below Torrington the coliform

densities were 26 to 163 times the common objective for sources of domestic water supply, and for general recreation, and 132 to 815 times the common objective for bathing. Such uses of the North Platte water, either in the river itself, or in irrigation canals drawing water from this reach of the river, would involve hazards to health.

BIOCHEMICAL OXYGEN DEMAND

Chart 5 presents information on average B.O.D. concentrations obtained during the December study.

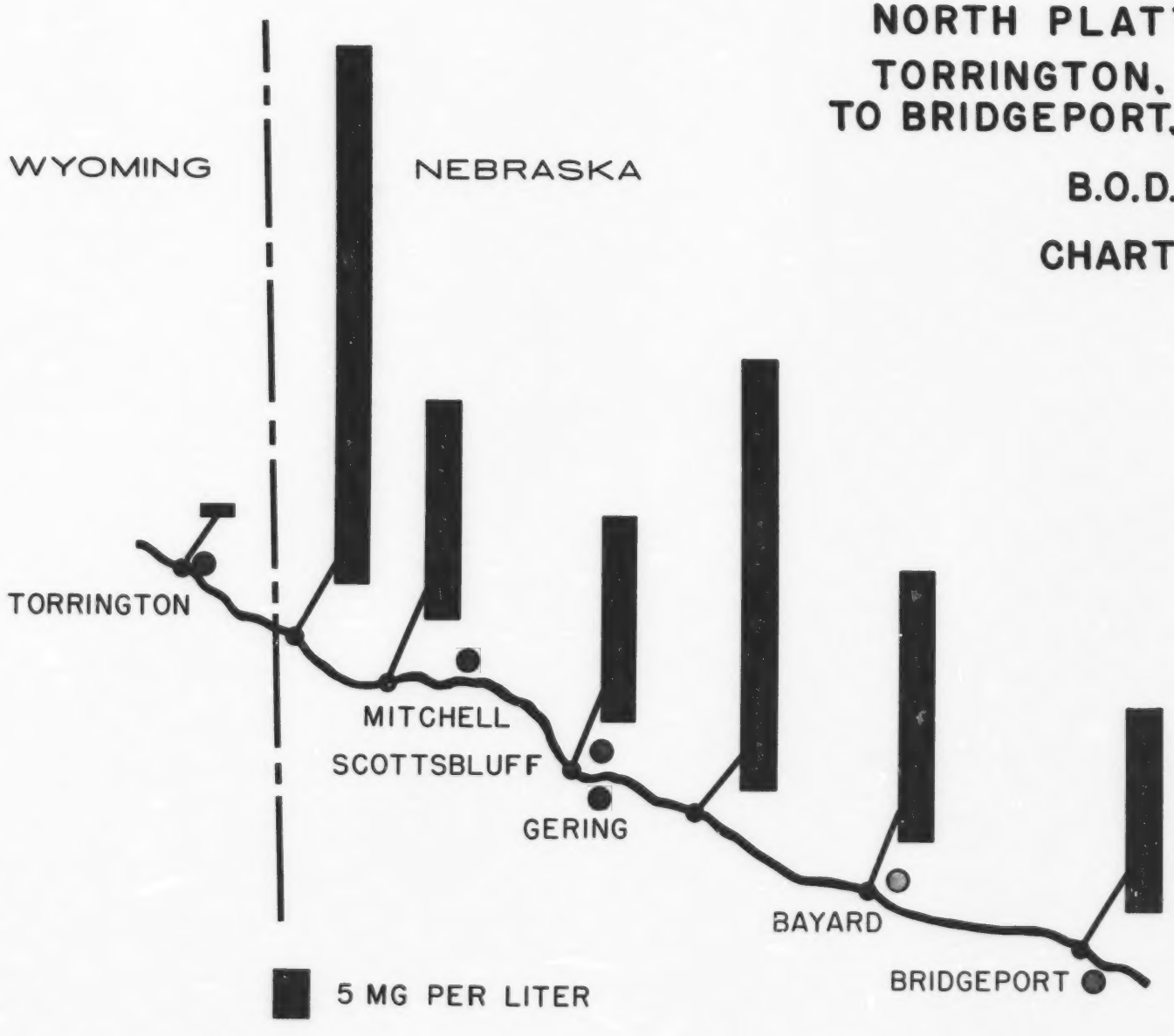
The B.O.D. trend in relation to sources of wastes generally was similar to that for the coliform bacteria.

Above Torrington (NP-208.8) the B.O.D. averaged 1.4 mg/l, which is typical of reasonably clean water. Near the state line (NP-199.0) the Holly Sugar Company wastes increased the average B.O.D. to 57.3 mg/l. Some residual of the B.O.D. from the Holly Sugar Company plant persists at all downstream stations, and contributes to the B.O.D. concentrations found at those stations.

NORTH PLATTE RIVER
TORRINGTON, WYOMING TO BRIDGEPORT, NEBRASKA

B.O.D.

CHART 5



At the next station downstream (NP-191.6) natural purification and dilution reduced the B.O.D. to 23.6 mg/l, and the decrease continued to 22.2 mg/l at the station just above Scottsbluff (NP-173.8). The wastes from the Great Western Sugar Company plant at Mitchell entered the river between the latter 2 stations, but dilution and natural purification combined prevented an increase in B.O.D. concentration at the Scottsbluff station. When B.O.D. concentrations and stream discharge data at the 2 stations are used to calculate the total waste loads in pounds per day an increase in load occurred, from 41,700 pounds of B.O.D. per day above Mitchell (NP-191.6) to 53,600 pounds per day just above Scottsbluff (NP-173.8). The 11,900 pounds per day increase is not a full measure of the load from the Mitchell plant, since it includes no allowance for the reduction accomplished by natural purification between Mitchell and Scottsbluff.

Near Minatare, below Scottsbluff (NP-165.6), the B.O.D. concentration increased to 46.4 mg/l. Although this concentration was less than the 57.3 mg/l below Torrington it represented a total organic load twice as

great as that below Torrington, because of the difference in stream flows. The B.O.D. load below Torrington was 86,000 pounds per day, compared to 172,000 pounds per day below Scottsbluff.

Downstream from the Minatare station the B.O.D. concentration decreased to 29.3 mg/l above Bayard (NP-154.6) and to 21.7 mg/l at Bridgeport (NP-141.8). Although the treated wastes from the Great Western Sugar Company plant at Bayard entered the river between these 2 points, both the B.O.D. concentration and the load in pounds per day were less at Bridgeport than they were above Bayard. The B.O.D. reduction by natural purification between the 2 points was greater than the B.O.D. added by the sugar plant wastes.

The B.O.D. determination is a measure of the amount of dissolved oxygen (D.O.) that is used by organic wastes during the process of decomposition. As such, it also is indirectly a measure of the concentration of unstable organic matter which will support the growth of biological organisms.

If waste organic matter uses D.O. of a stream faster than the D.O. is replaced by absorption from

the atmosphere and by photosynthesis the normal aquatic life, including fish, of the stream may be damaged seriously or even destroyed. Determination of the relationship between the oxygen demand of organic wastes,and the resulting D.O.,of a stream generally is undertaken to establish the concentration of organic matter that the stream can tolerate without causing excessive depletion of the D.O. The concentrations of organic matter that streams can tolerate without excessive D.O. depletion vary widely, depending on depths and turbulences of the individual streams. Stream pollution control authorities generally employ as a standard some minimum allowable D.O. concentration, commonly 5 mg/l, which will support normal aquatic life. This single value controls the concentration of B.O.D. which may be allowed in any individual stream, and which may vary widely from one stream to another. The use of the single D.O. standard is a convenient administrative tool, since it avoids the time consuming and expensive necessity for establishing many B.O.D. standards for a wide variety of streams, and even for different sections of a single stream.

While the D.O. standard is a convenient and widely used device it has its limitations. Some streams are so shallow and turbulent, with such high reaeration capacities, that they can accept extremely high concentrations of B.O.D. without excessive oxygen depletion. In such streams the organic matter which causes the B.O.D. may be deleterious to other aspects of water quality and use, regardless of how much or how little it may deplete the D.O. of the stream.

Excessive organic pollution, as reflected by B.O.D., can cause excessive growths of undesirable aquatic plant and animal life which may compete with and crowd out the normal flora and fauna of a clean stream, and diminish the usefulness of the stream just as effectively as would excessive oxygen depletion. In addition, high concentrations of organic matter may render water unsuitable both as a source of domestic water supply and for many industrial uses.

The swift, shallow reach of the North Platte under consideration has an extraordinary capacity for receiving high organic loads without suffering extreme D.O. depletion.

Serious oxygen depletion was not found during the December, 1960, survey, as is noted in the following section on dissolved oxygen. Nonetheless, average B.O.D. concentrations in the range of 21.7 to 57.3 mg/l indicate organic pollution that renders the water unsatisfactory for many uses. In those cases where pollution control agencies have adopted B.O.D. stream standards it generally is accepted that the oxygen demand should not exceed an average of 5 mg/l of 5-day 20° C. B.O.D. in reasonably clean streams. Downstream from Torrington average B.O.D. concentrations ranged from 4.3 to 11.4 times the 5 mg/l value.

DISSOLVED OXYGEN

As noted above, the average D.O. concentration did not fall below 5 mg/l at any station in this reach of the North Platte. The lowest average concentrations found were 5.44 mg/l below Scottsbluff (NP-165.6) near Minatare and 5.55 mg/l just above Bayard. At each of these stations one individual value of 7 observations was below 5 mg/l, being 4.71 mg/l at Minatare and 4.21 at Bayard.

Between Torrington and Scottsbluff the lowest average D.O. found was 8.57 mg/l near the state line (NP-208.8).

The samples were collected during a period of cold weather, and stream temperatures were 0° C. on most of the sampling days. With the same conditions of stream flow and waste discharge, but with the higher stream temperatures which occurred earlier during the sugar beet campaign somewhat lower D.O. concentrations than those found would have resulted.

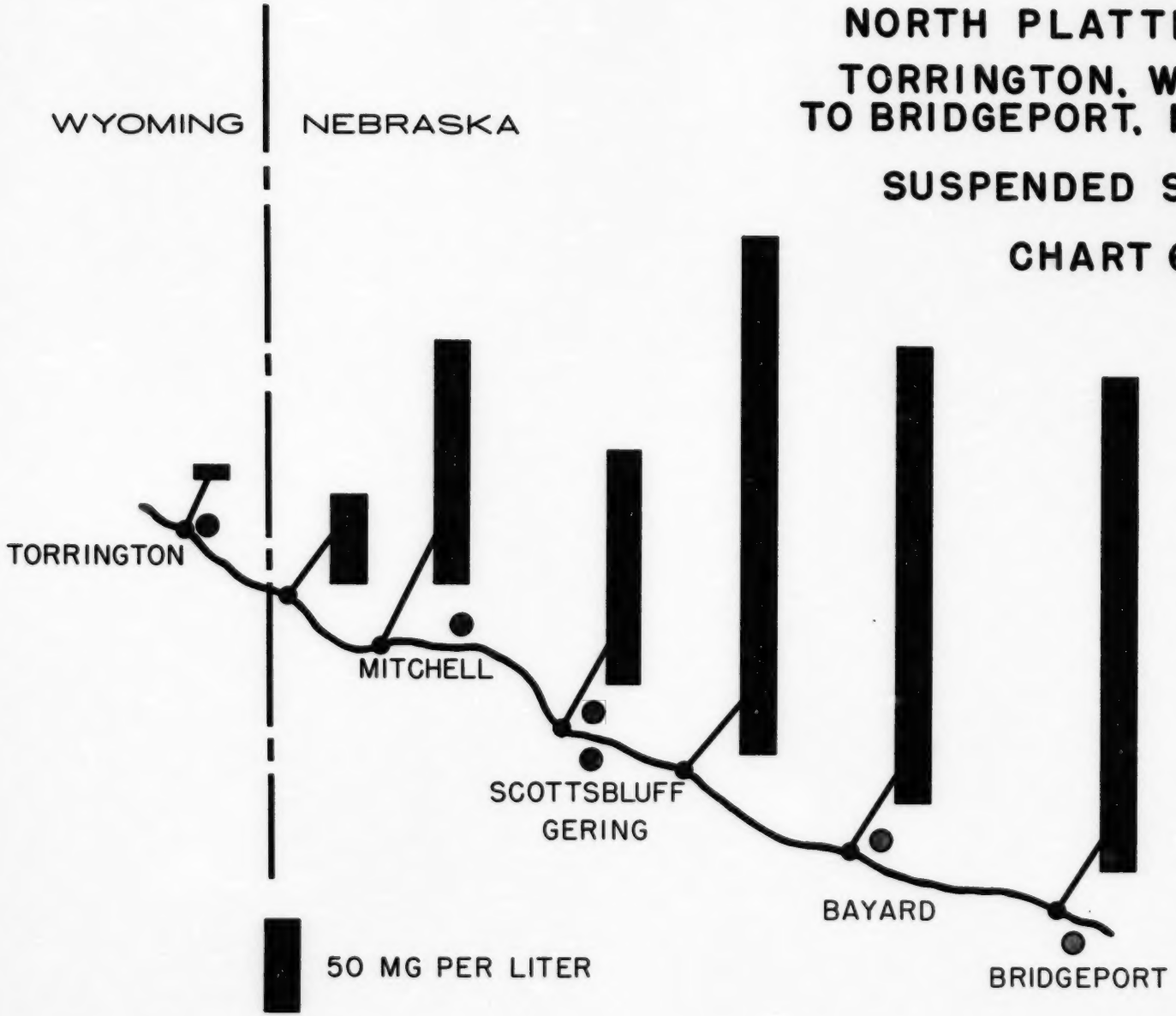
SUSPENDED SOLIDS

Chart 6 presents information on average suspended solids concentrations found during the December study.

Above Torrington the clear North Platte River carried very little suspended matter, with an average concentration of 7.8 mg/l.

The waste discharge from the Holly Sugar Company plant was sampled, and yielded an average suspended solids concentration of 3,160 mg/l. Based on a waste flow of 8.6 million gallons per day, the total weight of suspended solids discharged from the plant was 227,000 pounds, or nearly 114 tons, per day. Of this, 194,000 pounds per day, or 85.5 per cent, were fixed suspended solids. Most of the fixed solids presumably were soil washed from the beets during procersing.

NORTH PLATTE RIVER
TORRINGTON, WYOMING, TO BRIDGEPORT, NEBRASKA
SUSPENDED SOLIDS
CHART 6



At the next station downstream, near the state line (NP-208.8) the suspended solids increased to 48.9 mg/l, which represented a load of only 73,500 pounds per day. At the second downstream station (NP-191.6) near Morrill, the suspended solids increased to 133 mg/l, representing 235,000 pounds per day. Very little wastes enter between the 2 stations. Since the 235,000 pounds per day checks satisfactorily with the 227,000 pounds per day measured in the Holly Sugar Company waste discharge it must be concluded that the lower of the 2 stations more nearly represents the load of suspended solids imposed on the North Platte by the Holly Sugar Company wastes. Further investigation would be needed to explain the difference in results at the 2 stations.

There was a slight decrease in suspended solids at the station just above Scottsbluff, below the municipal sewage and sugar plant waste discharge from Mitchell. The concentration here was 128 mg/l, but dilution by increased stream flow accounted for this slight reduction. The total suspended solids load was 310,000 pounds per day, for an increase below Mitchell of 75,000 pounds per day.

Below Scottsbluff sewage and industrial waste discharges the solids increased to 284 mg/l, or 1,053,000

pounds per day, for an increase of 818,000 pounds per day, or more than 400 tons per day.

Just above Bayard the solids concentration decreased by dilution to 252 mg/l. Below the Bayard sewage and sugar beet waste discharges the concentration increased to 272 mg/l, and the load increased to 1,392,000 pounds per day, for an increase of 296,000 pounds per day.

In the entire reach of the North Platte the suspended solids cause the river to appear unsightly and diminish its appeal for recreation. Some of the solids settle to the bottom of the river and smother aquatic life that normally would develop there to serve as fish food. If need should arise for use of the river as a source of municipal or industrial water supply the suspended solids would increase the cost and difficulty of water treatment.

ALKALINITY

Alkalinity is one of the constituents of water that is increased by use for irrigation. This was the only constituent reflecting the effects of such use that was determined during the December study. Lime wastes discharged from sugar beet processing also increase alkalinity of the water.

Above Torrington the alkalinity of the North Platte was 217 mg/l, which is moderately high. Below Torrington the alkalinity increased to 247 mg/l, and above Mitchell it remained very nearly the same at 242 mg/l. The increase in load between Torrington and Mitchell represented 103,000 pounds per day.

Below Mitchell the alkalinity increased to 290 mg/l, for an increase in total load of 381,000 pounds per day.

Below Scottsbluff there was an increase to 379 mg/l, representing an increased load of 700,000 pounds per day.

At Bayard the concentration decreased slightly to 371 mg/l, but the load increased by 210,000 pounds per day.

Below Bayard, at Bridgeport, the concentration increased slightly to 379 mg/l, and the load increased by 310,000 pounds per day.

It is not possible to separate the sources of the increase in alkalinity between Torrington and Bridgeport, which was a total of 1,594,000 pounds or 797 tons per day. The total load carried by the river at Bridgeport was about 6 times that above Torrington. Contributing sources were the beet sugar plants, return flows from the irrigated farms, and the natural alkalinity of normal surface runoff.

While the alkalinity as such found in the North Platte is not a serious pollutant it is a measure of a portion of the total hardness, which can be objectionable in water used for domestic and many industrial purposes. The increase in alkalinity also is an indication that increases in several other mineral constituents probably result from use of the water for irrigation. The other minerals can interfere with reuse of the water for irrigation as well as for domestic and industrial uses. Further investigation of this aspect of pollution of the North Platte is needed to evaluate this potential problem.

VISUAL OBSERVATIONS

During early December, 1960, the North Platte River above the Holly Sugar Company plant was a beautiful, clear, sparkling stream which was a pleasure to observe. Below the plant the clarity of the river gave way to a murky brown appearance, and many large particles of suspended matter were obvious. This condition persisted downstream at least to Bridgeport, with the most objectional appearance occurring below the Scottsbluff-Terrytown-Gering area. Here the water was extremely dark, and appeared dull and lifeless.

The sewage and industrial wastes virtually destroyed the aesthetic appeal of this reach of the North Platte.

SUMMARY AND CONCLUSIONS

Pollution of the 67 mile reach of the North Platte River from Torrington, Wyoming, to Bridgeport, Nebraska, was investigated during December, 1960.

In Torrington, Wyoming, the river received beet sugar wastes from the Holly Sugar Company plant, and partially treated sewage from the plant employees. Torrington sewage was being impounded in stabilization ponds and there was no overflow of sewage to the river at that time. In Nebraska the river received raw sewage from 7 communities, and partially treated sewage from 2. Four beet sugar plants of the Great Western Sugar Company discharged wastes to the Nebraska reach of the North Platte. Of these, the plant at Bayard has facilities for broad field disposal of its wastes. In addition, wastes were discharged from meat, poultry, milk, vegetable, and oil processing plants. Many of the industries were concentrated in the Scottsbluff-Gering area.

The sewage discharges had an estimated bacterial contamination potential equivalent to that of the raw sewage from a population of 18,000 of which less than one per cent was discharged in Wyoming.

The sewage and industrial wastes had an estimated oxygen demand equivalent to that of the raw sewage from a population of 1,360,000. The Holly Sugar Company wastes in Wyoming accounted for more than one quarter of this total. This plant in combination with the 4 Great Western Sugar Company plants in Nebraska accounted for 95 per cent of the oxygen demanding wastes discharged to this reach of the river.

The sewage and the beet sugar and meat and poultry processing wastes contributed to extremely high concentrations of coliform bacteria in the river. Near the state line the average MPN of coliform bacteria was 329,000 per 100 ml, and below Scottsbluff the average MPN was 815,000 per 100 ml. The lowest average MPN found anywhere below Torrington was 132,000 per 100 ml above Morrill, Nebraska. These densities were 26 to 163 times the 5,000 per 100 ml which is indicative of reasonably satisfactory water quality. Use of the contaminated water either in the river,

or in the irrigation canals, for swimming, boating, fishing, or other uses which might involve ingestion of the water would present a health hazard to the users.

The organic wastes from the Holly Sugar Company plant produced a B.O.D. of 57.3 mg/l near the state line, which was the highest concentration found at any of the sampling stations. The next highest B.O.D. was 46.4 mg/l below Scottsbluff, and no value below Torrington was less than 21.7 mg/l. These concentrations were about 4 to 11 times the 5 mg/l which may be considered indicative of a stream that is only moderately polluted.

Below Torrington the suspended solids were 133 mg/l at Morrill, and they rose to a high of 284 mg/l below Scottsbluff. The increase in suspended solids from above Torrington to Bridgeport was 1,392,000 pounds per day, or 690 tons. Of this, 227,000 pounds per day was contributed by the Holly Sugar Company plant, and 743,000 pounds per day by the Scottsbluff-Terrytown-Gering area sewage and industrial complex. Although not revealed by the solids measurements in the flowing water, there were deposits of solids on the bed of the stream which essentially eliminated bottom life in the stream. This will be discussed more fully in the

separate report on biological findings. In addition, the suspended solids virtually destroyed the beauty of the stream, and would interfere seriously with treatment of the water for domestic or industrial uses.

Alkalinity of the river water increased throughout the stream reach under consideration, increasing from 217 mg/l above Torrington to 377 mg/l at Bridgeport. The increase was equivalent to 1,594,000 pounds per day, or 797 tons per day. A portion of the increase was caused by the lime used in sugar beet processing, and another portion by irrigation return flows. While the increase in alkalinity in itself was not serious it reflected an increase in hardness which could be objectionable in water used for domestic and industrial purposes. The increase in alkalinity also indicated a probable increase in other minerals which commonly are added to water used for irrigation. In sufficient concentrations such minerals can interfere with subsequent reuse of the water for irrigation.

The beauty of the river was virtually destroyed throughout the reach from below Torrington to Bridgeport. Little aesthetic enjoyment could be derived from viewing the murky, brown water, filled with suspended matter.

The wastes from the Holly Sugar Company plant at Torrington, Wyoming, seriously damaged water quality at and below the Wyoming-Nebraska state line, and residuals from these wastes added to the levels of pollution caused by sewage and wastes discharged by municipalities and industries in Nebraska.

The combined pollution from all sources: severely damages the potential fishery of this reach of the North Platte River; destroys the aesthetic appeal of the stream; renders recreational use of the water hazardous to health; and renders the water unsuitable as a source of supply for domestic and many industrial uses.

It is evident that pollution of the North Platte River by the Holly Sugar Company constitutes pollution of interstate waters subject to abatement under the Federal Water Pollution Control Act, as such pollution endangers the health or welfare of persons in a state other than that in which the discharge contributing to such pollution originates.

APPENDIX

NORTH PLATTE RIVER STREAM SURVEY
WYOMING-NEBRASKA
DECEMBER, 1960
RESULTS OF ANALYSIS

Station	Date Dec.1960	Time Collected	Flow cfs	Temp. °C.	pH	Alkalinity P(asCaCO3)	Alkalinity Total	Dissolved Oxygen mg/l.	Dissolved Oxygen % Sat.	BOD mg/l	BOD lbs/day	Total Suspended Solids mg/l	Total Suspended Solids lbs/day	Coliform MPN/100	Fixed Suspended Solids mg/l	Fixed Suspended Solids lbs/day
HS-1	7	1:45 PM		34								7,940			7,100	
	8	8:20 AM		34								4,700			4,140	
	9	10:30 AM		41								2,960			2,520	
	10	7:15 AM		35								836			528	
	11	7:40 AM		36								724			508	
	12	1:15 AM		38								1,860			1,460	
	13	9:40 AM		35								3,100			2,660	
Avg.				36								3,163			2,702	
NP-208.8	7	1:45 PM	278	2	8.2		216	11.40	94	1.11	1,666	8.0	12,000	91		
	8	8:20 AM	278	0	8.0		218	11.33	89	1.19	1,786	2.2	3,300	91		
	9	10:30 AM	278	0	8.2		216	9.49	75	1.13	1,696	9.0	13,500	< 36		
	10	7:15 AM	278	0	8.0		217	11.01	87	1.30	1,951	4.83	7,250	230		
	11	7:40 AM	278	0	8.1		214	11.06	87	2.04	3,062	4.5	6,750	430		
	12	1:15 PM	278	2	8.3	2.2	223	11.60	96	1.39	2,086	17.8	26,720	230		
	13	9:40 AM	278	0	8.2		216	11.30	89	1.71	2,567	8.5	12,760	430		
Avg.			278	0.5	8.1	0.3	217	11.03	88	1.41	2,116	7.83	11,750	214		
NP-199	7	1:15 PM	290	1	8.0		251	8.75	72	59.8	93,650	54.5	85,350	93,000		
	8	8:50 AM	270	0	8.0		249	8.58	68	50.7	73,920	49.0	71,440	460,000		
	9	11:00 AM	280	0	8.1		244	8.71	69	49.0	74,090	51.7	78,170	75,000		
	10	7:05 AM	280	0	8.0		249	8.51	67	63.0	95,260	48.5	73,330	240,000		
	11	8:10 AM	280	0	8.0		244	8.41	66	56.0	84,670	47.0	71,060	240,000		
	12	1:45 PM	275	2	8.2		254	8.44	71	63.0	93,560	45.0	66,820	93,000		
	13	9:20 AM	270	0	8.1		246	8.57	68	59.6	86,900	46.8	68,230	1,100,000		
Avg.			278	0.4	8.1		247	8.57	69	57.3	86,000	48.9	73,500	329,000		
NP-191.6	7	12:45 PM	328	0	8.1		243	9.39	74	22.8	40,380	146	258,600	43,000		
	8	9:20 AM	328	0	8.0		243	9.49	75	19.4	34,360	169	299,300	43,000		
	9	11:20 AM	328	0	8.1		248	11.33	89	23.0	40,730	150	265,600	93,000		
	10	6:45 AM	328	0	8.0		242	9.50	75	24.2	42,860	104	184,200	460,000		
	11	8:45 AM	328	0	8.1		238	9.44	74	20.8	36,840	150	265,600	93,000		
	12	2:10 PM	328	2	8.2		242	9.34	78	31.3	55,430	104	184,200	43,000		
	13	9:00 AM	328	0	8.1		240	9.42	74	23.5	41,620	106	187,700	150,000		
Avg.			328	0.3	8.1		242	9.70	77	23.6	41,740	133	235,000	132,000		

APPENDIX

NORTH PLATTE RIVER STREAM SURVEY (CONTINUED)

WYOMING-NEBRASKA

DECEMBER, 1960

RESULTS OF ANALYSIS

Station	Date Dec.1960	Time Collected	Flow cfs	Temp. °C.	pH	Alkalinity P(as $CaCO_3$)	Alkalinity Total	Dissolved Oxygen mg/l.	Dissolved Oxygen % Sat.	BOD mg/l	BOD lbs/day	Total Suspended Solids mg/l	Total Suspended Solids lbs/day	Coliform MPN/100	Fixed Suspended Solids mg/l	Fixed Suspended Solids lbs/day
NP-173.8	7	3:45 PM	466	0	8.1		290	8.47	67	25.9	65,160	133	334,600	150,000		
	8	11:00 AM	450	0	8.1		295	8.60	68	22.2	53,950	161	391,200	930,000		
	9	9:20 AM	450	0	8.1		293	8.30	65	19.0	46,170	152	369,400	---		
	10	8:05 AM	442	0	8.0		286	8.21	64	17.8	42,470	104	248,100	2,400,000		
	11	12:30 AM	446	1	8.1		288	8.10	66	21.2	51,050	130	313,000	930,000		
	12	2:45 PM	438	1	8.2		296	8.25	67	24.8	58,650	132	312,200	93,000		
	13	8:20 AM	434	0	8.1		283	8.44	66	24.7	57,870	86	201,500	430,000		
Avg.			447	0.3	8.1		290	8.34	66	22.2	53,620	128	310,000	704,000		
NP-165.6	7	9:15 AM	669	0	8.3	4.4	370	6.28	49	48.2	174,100	267	964,700	1,100,000		
	8	12:30 PM	701	1	8.1		365	5.80	47	40.4	152,900	272	1,029,500	750,000		
	9	8:50 AM	701	0	8.2		387	5.00	39	42.9	162,400	302	1,143,100	---		
	10	8:45 AM	683	0	8.1		378	5.07	39	41.5	153,000	263	969,900	430,000		
	11	12:05 PM	687	2	8.1		380	4.71	39	46.0	170,700	270	1,001,700	930,000		
	12	11:05 AM	683	0	8.3	0.6	402	5.67	44	46.1	170,000	335	1,235,500	750,000		
	13	7:55 AM	678	0	8.3	2.0	375	5.55	44	59.9	219,300	280	1,025,100	930,000		
Avg.			686	0.4	8.2	1.0	379	5.44	43	46.4	171,800	284	1,052,800	815,000		
NP-154.6	7	10:00 AM	805	0	8.4	1.6	341	6.90	54	28.2	122,600	175	760,700	240,000		
	8	1:05 PM	805	1	8.2		384	6.04	49	28.8	125,200	284	1,234,500	150,000		
	9	8:20 AM	805	0	8.2		372	5.41	43	24.3	105,600	284	1,234,500	930,000		
	10	9:10 AM	805	0	8.1		365	5.37	42	24.6	106,900	268	1,165,000	930,000		
	11	11:35 AM	805	1	8.2		369	4.21	34	> 37.1*	-	240	1,043,300	930,000		
	12	10:30 AM	805	0	8.1		382	5.63	44	31.9	138,700	270	1,173,700	430,000		
	13	7:30 AM	805	0	8.3	2.0	382	5.31	42	37.9	164,800	244	1,060,700	150,000		
Avg.			805	0.3	8.2	0.5	371	5.55	44	29.3	127,300	252	1,096,000	537,000		
NP-141.8	7	10:30 AM	943	0	8.2		330	8.81	69	16.0	81,470	143	728,100	93,000		
	8	1:40 PM	952	0	8.2		436	8.06	64	29.3	150,600	458	2,354,100	75,000		
	9	7:45 AM	972	0	8.1		382	7.90	62	20.2	106,000	278	1,458,900	460,000		
	10	9:35 AM	952	0	8.1		397	7.93	62	23.7	121,820	332	1,706,500	460,000		
	11	11:05 AM	943	0	8.1		369	7.48	59	20.2	102,860	274	1,395,200	390,000		
	12	9:50 AM	943	0	8.1		374	8.03	64	23.6	120,170	240	1,222,100	240,000		
	13	7:05 AM	896	0	8.2		354	8.11	64	18.9	91,440	182	880,050	240,000		
Avg.			943	0	8.1		377	8.04	63	21.7	110,620	272	1,392,170	279,000		
NP-62.0	9	3:15 PM		3				13.60	116							
	12	8:00 AM		2				13.07	109							
Avg.								13.33	112							

*Omit